IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

WANG

Serial No. 09/735,503

Filed: December 14, 2000

Title: METHOD USING SECONDARY ORIENTATION TO TUNE BUCKET NATURAL FREQUENCY

Atty Dkt. 839-820
        C#   M#

Group Art Unit: 1725

Examiner: Tran, Len

Date: April 4, 2002

RECEIVED
APR 0 9 2002
TC 1700

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

REQUEST FOR RECONSIDERATION

This is a response/amendment/letter in the above-identified application and includes an attachment which is hereby incorporated by reference and the signature below serves as the signature to the attachment in the absence of any other signature thereon.

Fees are attached as calculated below:

Total effective claims after amendment   **0**   minus highest number
previously paid for   **20**   (at least 20) =   0   x $ 18.00 $ 0.00

Independent claims after amendment   **0**   minus highest number
previously paid for   **3**   (at least 3) =   0   x $ 84.00 $ 0.00

If proper multiple dependent claims now added for first time, add $280.00 (ignore improper) $ 0.00

Petition is hereby made to extend the current due date so as to cover the filing date of this paper and attachment(s) ($110.00/1 month; $400.00/2 months; $920.00/3 months) $ 110.00

Terminal disclaimer enclosed, add $ 110.00 $ 0.00

☐ First/second submission after Final Rejection pursuant to 37 CFR 1.129(a) ($740.00) $ 0.00
   ☐ Please enter the previously unentered   , filed
   ☐ Submission attached

                                                      Subtotal $ 110.00

If "small entity," then enter half (1/2) of subtotal and subtract   -$ 0.00
   ☐ Applicant claims "small entity" status.   ☐ Statement filed herewith

Rule 56 Information Disclosure Statement Filing Fee ($180.00) $ 0.00

Assignment Recording Fee ($40.00) $ 0.00

Other: 0.00

                                  TOTAL FEE ENCLOSED $ 110.00

The Commissioner is hereby authorized to charge any <u>deficiency</u>, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Account No. 14-1140. A <u>duplicate</u> copy of this sheet is attached.

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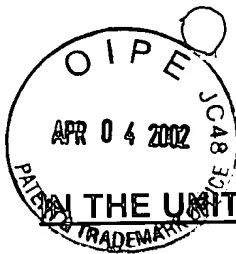Telephone: (703) 816-4000
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NIXON & VANDERHYE P.C.
By Atty: Alan M. Kagen, Reg. No. 36,178

Signature: _A. m. K._

#5 4/10/02

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Atty. Ref.: 839-820

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For: METHOD USING SECONDARY ORIENTATION TO TUNE BUCKET
NATURAL FREQUENCY

* * * * * * * * * * *

April 4, 2002

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

REQUEST FOR RECONSIDERATION

In response to the Office Action dated December 5, 2001, the period for

response having been extended one month by petition herewith, Applicant

respectfully requests reconsideration of the above-identified patent application in

view of the following remarks.

On page 2 of the Office Action, the disclosure was objected to and claims

1-8 were rejected under 35 U.S.C. 112, second paragraph. The Office Action

contends that the specification does not describe how the natural frequency is

being tuned. To the contrary, however, the specification describes that the

secondary orientation can be used to tune torsional frequencies without affecting

the flexure frequencies. See, e.g., page 3, lines 16-22. The secondary

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orientation is defined by the angle θ_s between the engine axial direction X and the material direction X', which is the same as the angle between the engine tangential direction Y and the material direction Y'. See, e.g., Figure 1 and page 3, lines 2-7. Figures 2 and 3 show the change of specific frequencies as a function of the secondary orientation. Additionally, the specification describes that the secondary orientation is controlled by placing the crystal seed along a desired direction in, for example, a known investment casting process. See, e.g., page 4, lines 8-19.

During a design process, when a particularly frequency, for example, a 1T frequency, is within the required margin, a redesign process has to take place to move the frequency out of the margin of the excitation frequency. This process is termed "frequency tuning." As noted, Figures 2 and 3 show how various frequencies change as the secondary orientation changes. Therefore, to tune a particular frequency, one can use these figures to determine the secondary orientation to optimize the frequency margin. For example, if the current secondary orientation in design is set at 30 degrees, and the current 1T frequency is found to have a 6% margin above a certain excitation frequency, and the design practice requires a 10% margin for 1T mode, one can change the secondary orientation from 30 degrees to 75 degrees by the use of Figure 2. Figure 2 shows that when the secondary orientation is changed from 30 degrees to 75 degrees, the 1T frequency will increase by 4.5%. Therefore, the margin at 75 degrees will be (6% + 4.5% = 10.5%), other parameters being kept constant.

Applicant thus respectfully submits that frequency tuning according to the present invention is clearly and adequately described in the specification.

The Office Action further contends that the specification does not explain the meaning of 1T, 2T, 1-2S and 1-3S. Applicant respectfully submits, however, that these frequency designations are terms of art that would be readily apparent to those of ordinary skill in the art. For the Examiner's convenience, the following explanation is provided. The vibration modes of a blade are often classified by their mode shapes. Among the mode shapes, important ones include flexure or bending modes (F modes), torsional modes (T modes), and stripe modes (S modes). Among each class of mode shape, they can be further classified by their orders, for example, the first flex modes (1F), second flex modes (2F), the first torsional modes (1T), the second torsional modes (2T), and the first 2 stripe (1-2S), and the first 3 stripe (1-3S), etc. These mode shapes can be identified through nodal lines and/or mode animations. Since these designations would be readily apparent to those of ordinary skill in the art, Applicant respectfully submits that this objection is misplaced.

Reconsideration and withdrawal of the objection and rejection are respectfully requested.

Claims 1-8 were rejected under 35 U.S.C. 102(b) or, in the alternative, under 35 U.S.C. 103(a) over U.S. Patent No. 4,605,452 to Gemma et al. This rejection is respectfully traversed.

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The Office Action recognizes that Gemma lacks any reference to tuning a natural frequency. Notwithstanding, the Office Action concludes that "tuning a natural frequency is an inherent property, since the arranging of the single crystal involves the tuning of a natural frequency."

In this context, however, it is important to note that fatigue and frequencies are two distinct behavior and phenomenon and are governed by different physical processes and mathematical descriptions. For example, fatigue is dependent on stresses and local temperatures and thus a local or point property. In a structure, if at a particular point the stress and temperature is high so that the fatigue life is low, the structure will fail due to the failure of that point, regardless of the status at other points. Frequencies, on the other hand, are global properties. The frequencies of a particular structure depend on the stiffness distribution in the structure. The change of stiffness at a local point does not have a significant impact on the frequency of the structure. Indeed, the approaches to solve problems in these two subjects are distinctly different.

Moreover, as would be apparent to those of ordinary skill in the art, the method to optimize fatigue is incompatible with and does not work for the optimization of frequency. Actually, in the Gemma patent, the method to optimize fatigue is to set the secondary orientation such that the orientation is tangent to the blade surface in the critical crack prone regions just behind the leading edge of the air foil at about 40-80% of the air foil span. According to the Gemma patent, "a representative improved gas turbine blade will have a

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secondary orientation angle of -10 to +20 degrees . . .." See the Abstract. Thus, Gemma's method produces an optical secondary angle of -10 to 20 degrees, while the method according to the present invention could produce a secondary angle of any value (based on the current margin and Fig. 2 and Fig. 3 and method of tuning).

Still further, Gemma's invention is not to control the secondary orientation but to use the secondary orientation to reach a certain objective (to optimize fatigue in particular). Optimizing frequencies, however, cannot be derived from optimized fatigue. The two methods are independent and distinctively different from each other as discussed above.

As a consequence, Applicant submits that Gemma lacks at least the step of tuning a natural frequency of the turbine bucket without modifying physical features of the turbine bucket as set forth in claim 1. Additionally, Applicant respectfully submits that Gemma lacks the claimed steps of placing a crystal seed along a desired orientation relative to an engine axial direction, and investment casting the turbine bucket with a single crystal alloy, wherein the desired orientation is selected to tune torsional frequencies without affecting flexure frequencies as set forth in independent Claim 6. As a consequence, Applicant submits that the rejection under 35 U.S.C. 35 U.S.C. 102(b) is misplaced.

Moreover, with reference to the comments above, Applicant submits that Gemma lacks any suggestion of modifying its method to utilize secondary

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orientation to optimize frequencies. Indeed, it is well settled that "the mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Fritch*, 23 USPQ2d 1780 (Fed. Cir. 1992). Nowhere does Gemma even remotely suggest the desirability of such a modification. In fact, Gemma is silent with respect to tuning a turbine bucket frequency. As a consequence, Applicant additionally submits that the rejection under 35 U.S.C. 103(a) is also misplaced.

Reconsideration and withdrawal of the rejection are respectfully requested.

In view of the foregoing remarks, Applicant respectfully submits that the claims are distinguishable over the references of record and that the application is in condition for allowance. Should the Examiner believe that anything further is desirable in order to place the application in condition for allowance, the Examiner is invited to contact Applicant's undersigned attorney at the telephone number listed below.

Prompt passage to issuance is earnestly solicited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

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